direction more than one message at a time must be looked upon as little more than feats in 'intellectual gymnastics,' very beautiful in their way, but quite useless in a practical point of view." Such assertions should teach all scientific writers the lesson of "hoping all things not impossible, believing all things not improbable," an attitude of mind which, Sir John Herschel remarks, should always characterise the natural philosopher, and which, in the present day, is certainly the safest one. Within six years of the publication of the foregoing statement duplex telegraphy was not only largely employed in actual telegraphy, but its use on certain busy lines became absolutely indispensable. The change from theoretical to practical success is due to an American, Mr. J. B. Stearns, who in 1872 succeeded in overcoming the main obstacle in duplex telegraphy, namely, what is known as the static discharge from the line. This Stearns accomplished by using a "condenser"; and further he developed a system of "duplexing" the line similar to the principle of the Wheatstone bridge.

FIG. 1.

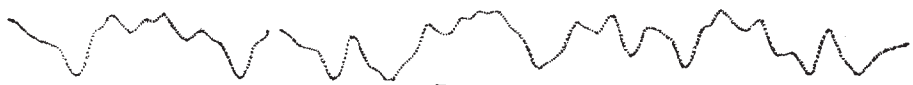

FIG. 2.

More or less successful attempts were afterwards made to duplex submarine cables, and in the early part of 1877 Mr. J. Muirhead succeeded in duplexing the cables of the Eastern Telegraph Company by his artificial condensers. But we believe that his success was only partial. Subsequently Mr. Muirhead has been at work duplexing the Direct United States Cable with some prospect of success, and this week Stearns, who may be called the father of duplex telegraphy, has actually achieved the great feat of perfectly duplexing the Anglo-American Cable. In a message received by Mr. W. H. Preece this week, Mr. Stearns says, "I managed to get some

FIG. 3.

specimens for you this morning, though we had no time to make the balance *especially* perfect for the purpose. No. 1 shows signals received single; No. 2, ditto, duplex. No one can tell the difference. No. 3 is our balance while keying, but not receiving. No. 4 shows the balance perfect at first, but destroyed and restored again by the adjuster. It shows with what facility the ordinary adjustments can be made after the balance is once obtained. The whole time occupied by slip No. 4 was about twenty seconds."

To understand these drawings our readers must know that all the messages now sent across the Atlantic are

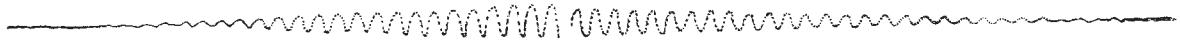

FIG. 4.

automatically registered by means of Sir W. Thomson's delicate and beautiful siphon recorder, which spirts out little jets of ink in a fine stream on a moving ribbon of paper. When no current passes the ink-marks form a straight line, but a current causes this line to deviate to the right or left, according to the direction of current. Hence the ordinary right and left strokes of a needle instrument or the long and short dashes of a Morse are here indicated by marks above and below the middle line. Thus the balance is shown by the almost perfectly straight line in Fig. 3 and the messages in Figs. 1 and 2.

The essence of duplex telegraphy is to obtain an electrical balance round on the line such that the sending instrument is not affected by currents circulating round it coming from the sending end, but only by currents received from the opposite end, and *vice versâ*. Hence, if the balance be once obtained, double transmission is possible. This balance Stearns has succeeded in obtaining by the use of his system as applied to land lines, and without the aid of the additional arrangements of artificial condensers used by Dr. Muirhead.

THE ROYAL SOCIETY MEDALLISTS

THE following are the awards of medals by the Council of the Royal Society for the present year. The medals will be given away at the Society's anniversary meeting on the 30th inst.:—The Copley Medal to M. Jean Baptiste Boussingault for his long-continued and important researches and discoveries in agricultural chemistry; a Royal Medal to Mr. John Allan Broun, F.R.S., for his investigations during thirty-five years in magnetism and meteorology, and for his improvements in methods of observation; a Royal Medal to Dr. Albert Günther, F.R.S., for his numerous and valuable contributions to the zoology and anatomy of fishes and reptiles; the Rumford Medal to M. Alfred Cornu, for his various optical researches, and especially for his recent re-determination of the velocity of propagation of light; the Davy Medal to MM. Louis Paul Cailletet and Raoul Pictet, for their researches, conducted independently but contemporaneously, on the condensation of the so-called permanent gases.

Jean Baptiste Boussingault was born in Paris in 1802. He was educated at the Mining School of St. Étienne, after leaving which he became connected with an English company formed to recover and work some mines in South America. This project, however, turning out unsatisfactory, after a considerable time spent in scientific travel in that continent, he returned to France and commenced those researches with which his name is more closely allied, the most important of which lie in the domain of agricultural chemistry. Probably his investigations of greatest value are those in which he has determined the quantities of carbon, nitrogen, and hydrogen found in plants, and his comparison of these with the amounts of the same constituents supplied to the plant by manures, &c. During these investigations he has shown, by a series of most conclusive experiments, the inaccuracy of the theory "that plants in their growth

derive nitrogen from the air," but, on the contrary, has pointed out that all the nitrogen assimilated by them may be accounted for in the different compounds of that body which are supplied to the plant in other ways. Boussingault's experiments also on the nutritive properties of the nourishment supplied to herbivorous animals are of great interest. In these he has traced the distribution of the various constituents of the food by the vital process, and has determined the different quantities of the various constituents which undergo assimilation. Besides investigations in the directions just indicated, he has introduced various improvements in methods of analysis, and has published many valuable articles, most of which are collected in his "Mémoires de Chimie Agricole et de Physiologie;" he has also written a work entitled "Traité d'Economie Rural."

With the work of Mr. J. Allan Broun most of our readers must be familiar. On the commencement of magnetic observations he indicated the errors or insufficiencies of the methods for determining coefficients and correcting the observations issued by the committee of the Royal Society for the instruction and direction of superintendents of observatories; he devised new methods for these ends which have made the observations in all the magnetic observatories available for strict scientific conclusions. He has made investigations in magnetism and meteorology during thirty-five years; among the new results obtained many of them are of the highest value, and have taken their place as standard scientific data. He established an observatory twice on a mountain-peak 6,000 feet above the sea, with the complement of instruments employed in first-class observatories (on the second occasion with a double series of magnetical instruments)—this, in a wild country, done amidst great difficulties in erecting instruments and obtaining trained observers, requiring continued and persevering action. This and many other duties were done at his own expense, and though, in general, ultimately repaid, they yet included considerable pecuniary loss. He also spent his own means in obtaining new instruments, and in every matter likely to forward science. He has laboured for years without remuneration in scientific work of a peculiarly tedious kind.

Albert C. L. G. Günther is the Keeper of the Zoological Department of the British Museum, a position to which he succeeded on the death of Dr. J. E. Gray. Very early in his life he devoted himself to the study of the natural sciences, and, if we are not mistaken, his earliest essay as an author was a very complete memoir of the fishes of the Neckar. About 1854 he accepted an appointment in the British Museum under Dr. J. E. Gray, who soon learned to value and appreciate the services of his assistant. Dr. Günther commenced the investigation and arrangement of the batrachian reptiles in the National Collection, with a zeal and energy that knew no limits, and which soon rendered this portion of the Zoological Department without a rival among the Museums of Europe. Not wearied by such a task he set about a far greater one, the arrangement and description of the immense class of the fishes, and no zoologist has ever raised a greater or more enduring monument to his memory than Dr. Günther has done in his great and truly scientific catalogue of all the known fish. The care of a large and daily-increasing collection, with all the worry incident on the want of room to properly store it—the toil and labour involved in the publication of the extensive work just alluded to, might well have excused Dr. Günther from attempting other work, but still we find him apparently never weary, and memoirs of a value like those on Hatteria, on Ceratodus, and on the Giant Tortoises, not to mention a long list of others, were being constantly published by him. He is also the author of an important work published at the expense of the Ray Society, "On the Reptiles of British India," and joint author with Col. Playfair of a work on the "Fishes of Zanzibar." All will agree that his name is a very worthy one to be added to the grand roll call of the Royal Society's medallists.

The name of M. Alfred Cornu must be familiar to the readers of NATURE in connection with his remarkably ingenious and successful method of determining the velocity of light. A detailed account of M. Cornu's method will be found in vol. xi. p. 274, and succeeding volumes of NATURE. It was also expounded by him, it may be remembered, at the Royal Institution, on May 7, 1875. The important bearings of M. Cornu's experiments in various directions, we need not point out; its value in attaining an accurate estimate of the sun's parallax is evident. As is evidenced by the *Comptes Rendus*, M. Cornu's work in his own department is constant and varied; his research into the spectrum of the star that appeared in Cygnus two years ago was a fine example of the result of spectroscopic research; an account of it will be found in NATURE, vol. xv. Although probably the youngest of the new medallists, M. Cornu's long and incessant work makes him almost a veteran in scientific research.

MM. L. Cailletet and Raoul Pictet have lately been so closely engaged in the same kind of experimental work, namely, the liquefaction of gaseous bodies, that their names have naturally become associated in connection with the important results which have followed their independent researches. The methods, however, employed by the two chemists in obtaining those results which have lately added so much to their reputation are to a certain extent different. Cailletet's experiments, which were conducted on the gases air, hydrogen, marsh gas, nitric oxide, and carbonic oxide, depend for the cold necessary to produce the liquefaction of the gas, on the expansion of the gas when suddenly compressed only at moderate degrees of cold.

Pictet's experiments, on the other hand, are the result of his endeavours to discover improved methods for producing and maintaining for a considerable time very low degrees of temperature. Combining these improvements with the production of the bodies to be liquefied under great pressure, he has succeeded in liquefying oxygen and hydrogen and in solidifying the latter. He has also determined the specific gravities of the gases when in that condition, assigning to them the weights ·9883 and ·9787. Besides his most recent researches on the condensation of gases, M. Pictet has carried out other investigations on those phenomena, the consideration of which lies between the provinces of physics and chemistry. Among such investigations may be mentioned his observations on the application of the mechanical theory of heat to the study of volatile liquids and to some simple relations between the latent heats, atomic weights, and tensions of vapours. M. Pictet has also been successful in applying his scientific investigations to practical use, in the perfecting of apparatus for the rapid production of large quantities of ice.

We are glad to know that the health of M. Pictet is not so seriously impaired by overwork as was rumoured a few days ago. On the best authority it is stated that his recovery is by no means beyond hope, and that he is not suffering from incipient softening of the brain. There is no contradiction, however, to the sad statement that the sight of one of M. Pictet's eyes is gone, and that he will probably lose the power of the other.

AFGHANISTAN

WHATEVER opinions our readers may hold as to the present action of the Government with respect to Afghanistan, it may not be considered inappropriate to summarise briefly what we know about a country, which at no remote date may become a part of the British